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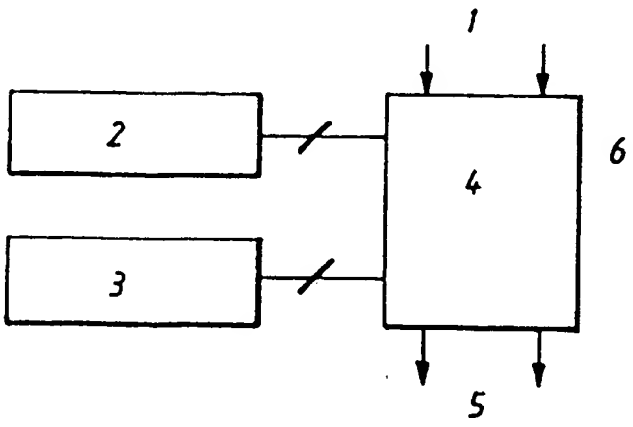
(54) Title: ARRANGEMENT IN A COMMUNICATIONS NETWORK

(57) Abstract

In a communications network, first information items are transmitted synchronously and second information items asynchronously. The second information items can be overlaid on the synchronously transmittable first information items. A bandwidth accessible on transmission can be variably distributed between the said first and second information items and, with the desired variable distribution, transmitting and receiving units become synchronized by means of synchronization information which can be transmitted via a channel established for asynchronous transmission between the transmitting and receiving units.



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TITLE

Arrangement in a communications network

TECHNICAL FIELD

The present invention relates to an arrangement in a digital communications network for transmitting synchronously transmittable first information items, for example speech, video and/or data, and asynchronously transmitted second information items, for example data.

PRIOR ART

The invention can be used, inter alia, in connection with the so-called "hardware platform" corresponding to the longitudinal layer of the OSI model, in which, especially, the MAC part is of interest. The invention also takes into account the existing physical layers and utilization of current software which is included. The invention can be used inter alia in the so-called DTM protocol which can be used in the MultiG project and reference can also be made to the proposed standard IEEE 802.9.

Circuit switching has traditionally been considered to be good for transmitting speech. In digital communication, synchronous and asynchronous multiplexing is mentioned. In synchronous multiplexing, the information is transmitted in channels which consist of time slots which are permanently allocated in advance. The communication is connection-oriented, that is to say must be preceded by a call set-up. A time interval can contain time slots for different channels. One cycle of recurrent time slots is called a frame. The synchronous multiplexing is one way of implementing circuit switching.

In connection with the integration of speech, video and data in local networks, it is quite generally known to produce dynamic bandwidth allocation. Bandwidths which are not used for speech and image communication will be accessible for asynchronous data communication. It is known per se to utilize a system of the token-ring type and message coding with differential Manchester

coding. In connection with this, it has been proposed to utilize the token-ring system in a time-division multiplexed connection.

Reference is made to, among others, American patent specification 4866704 which describes an asynchronous fibre optical local area network. The network supports data packet traffic together with synchronous voice traffic over a common token-ring channel.

From American patent specification US 4843606 it has previously been known to utilize a communications system in local connection with the token-ring principle. Synchronous bandwidth management is utilized for giving prioritized functions for quasisynchronous frames with regular intervals. The "rings" are mutually connected through a time-division multiplex unit via its synchronous bandwidth manager. Buffers are arranged in each synchronous bandwidth manager for synchronous information blocks transmitted from and to a respective ring. A TDM control unit utilized can independently reach the said buffers for TDM rerouting via individual bytes in the information block which can consist of voice information. The buffer arrangement can include FIFO buffers. The rings are also mutually connected within a "backbone" bus or ring for transmitting asynchronous data between the rings. The number of rings can be one or more.

Reference is also made to American patent specification 4785448, which relates to a local area telephone system for simultaneous transmission of digital data and analogous voice signals on the same transmission medium. The station units are physically connected in a star configuration. Token-ring transmission is also utilized. Moreover, Manchester coding is utilized.

Reference is also made to American patent 4553234 which relates to a broadband local area network with token-ring transmission and time-division multiplex in both circuit-switched and packet-switched traffic. In connection with the known arrangement, data, image and speech traffic is transmitted, among others.

In American patent specification 4459558, a

token-ring protocol for a local area network is utilized. A ring binds together a plurality for forming a local area network. The respective station is allocated one or more of three priority levels corresponding to service types. The highest level guarantees a bandwidth, for example for digital voice data. The second level relates to interactive data communication without absolute bandwidths guarantee. Level 3 relates to low-priority transmission.

DESCRIPTION OF THE INVENTION

TECHNICAL PROBLEM

Use of personal computers in networks continues to increase conspicuously. In connection with this, there is a need to be able to utilize generally acceptable systems of the Ethernet or token-ring type which cope with transmitting speech and image in real time. The integrated communication can be seen as a precondition for increased use of personal-computer-based speech and video services in the companies. In practice, however, it is an advanced technical problem to be able to implement protocols of the said type in such a manner than an effective and appropriately operating network is obtained. The present invention intends to solve this problem, among others.

It will be possible to transmit speech and video with good quality in a special transmission. Important parameters in connection with services which contain images or sound are the delay and the variation which can be found in the delay. A sensitive parameter in this respect is the variation in delays, so-called jitter, which implies that the delay is different at different times. In video, such variations are experienced as discontinuities. Sound is even more sensitive. Existing networks can be divided into two types on the basis of the said delay hypothesis. The first type is of the asynchronous type and characterized by unspecified delay which leads to unspecified jitter. The asynchronous principle is normally associated with non-real time

applications and is thereby less suitable for video and sound. The second type is of the synchronous type and is characterized by specified delay and specified jitter and can therefore be utilized as a suitable transmission medium for video and sound. The present invention is based on this knowledge.

The present invention is also based on the fact that there will be a varying requirement for bandwidth. For it to be possible for this to be met, an access method is required which involves dynamic allocation of bandwidths. Disregarding the D channel in basic access in ISDN, which has a speed of 16 kbit/s, the minimum speed is 64 kbit/s for a B channel. The image coding standard H.261 prescribes communication channels which are multiples of 64 kbit/s, which should be the minimum units for bandwidth allocation. The present invention also takes into account this relationship.

In accordance with the invention, the protocol utilized should provide minimum delay and minimum variations in the delay with speech and image transmission. In one embodiment, it will also be possible to utilize a "real" LAN access protocol. The aim with such a protocol is that the communications medium will be allocated by the associated nodes and that the exchange functions will be distributed (non-centralized exchange). The principle of the protocol will also be such that it can be used both with speeds corresponding to those which are used today for Ethernet and token-ring and higher speeds for future development. For the asynchronous part, which it will be possible in one embodiment to use in the same way as current LAN data communication, it will be possible for some combination of existing protocol for data link layers and physical layers to be used for avoiding new design. The invention will also entail that it will be possible to use network software which is already in existence. The invention will also be able to comply with the use of advanced communication circuits for LAN data communication to as great an extent as possible. The protocol will enable dynamic allocation of bandwidths to

be provided for the different communication channels. Bandwidths which are not used for speech and image communication will be accessible for the common asynchronous LAN data communication. It will be possible to utilize a common asynchronous channel for LAN data communication. It will be possible to vary the channel bandwidths dynamically. If a number of asynchronous channels is used, the bandwidth is reduced for each channel to a corresponding degree. The invention takes into account the said characteristics and also solves this complex of problems.

SOLUTION

That which can be mainly considered to be characteristic of the arrangement according to the invention is that the second information items asynchronously transmitted and mentioned in the introduction can be overlaid on the first information items which can be transmitted synchronously, that on transmission accessible bandwidths can be variably distributed between the said first and second information items, and that, in the desired varied distribution, transmitting and receiving units become synchronized by means of synchronization information which can be transmitted via a channel established, for example, for the synchronous transmission, between the transmitting and receiving units.

In one embodiment, the arrangement operates with a synchronous first protocol of the DTM type and an overlaid asynchronous second protocol of the token-ring type which operates with high access fairness, which first and second protocols form a hybrid access protocol. In one embodiment, the synchronous protocol is arranged for dynamic bandwidth allocation and the overlaying effected by means of the second protocol is arranged to occur in at least one time slot with a variable number of bits. Setting up and clearing or coupling in and out of synchronous connections is carried out via a data communication channel, preferably an asynchronous data communication channel. In one embodiment, the arrangement

comprises or forms an ISDN-compatible business exchange with connection-oriented speech, video and/or data communication and connectionless data communication. Connectionless is here meant to be a connection which is not determined in advance. In a further embodiment, the arrangement comprises a number of function terminals, which means terminals for managing data and speech, video, music and so forth. The said terminals can thus consist of personal computers. The arrangement operates with image communication, preferably in the range of 64 kbit/s to 2 Mbit/s. In one embodiment, the arrangement utilizes a combination of DTM and token-ring principles. Characteristics, for example topology, transmission rate and/or coding and so forth from the token-ring concept are used as a complement to the DTM concept. The arrangement can be considered to consist of or include an access protocol for integrating speech, video and data in a local area network for speeds up to about 20 Mbit/s. In a preferred embodiment, the arrangement consists of a local area network with personal computers which can be used for all types of communication, primarily speech and data. In a preferred embodiment, the arrangement forms a local area network which, in relation to the network, renders unnecessary a separate business exchange or business exchanges which can be represented by software in the local network. The said network can thereby communicate with external ISDN communication via one or more bridges from or to one or more communication servers. A respective terminal in the local network and respective server can thereby be arranged with an interface to the local network. The said local network is transparent for normal data communication occurring in the network. In one embodiment, a universal network is created with universal terminals. The arrangement functions both for narrow-band technique and broadband technique.

ADVANTAGES

What has been proposed above provides a protocol

with a number of good characteristics. It thus becomes possible to utilize a technique which builds on existing known circuits in connection with the token-ring. It thus becomes possible to integrate speech and data in a local area network by switching together ISDN business exchanges with a LAN via a bridge which makes it possible to utilize standard components. Using the invention, a local area network can be offered which copes with different types of communication in one network. Business exchange services in the local area network can replace a small business exchange. Telephony with a possibility for data support in the personal computer and access to a large number of ISDN services can be expected to provide increased supply of existing communications assortment. A provider of a local area network can also offer telephone services in connection with these. Multi-functional terminals in a local-area multi-services network correspond to ideas which form the basis of the public ISDN network and are in accord with the development expected in the telecommunications field. Products for local area networks can be offered and ISDN products can be interconnected in local area networks according to the invention. The invention makes it possible to utilize known protocols for synchronous communication for speech, video and data. In this respect, reference can be made to DTM which operates with little delay and with dynamic broadband allocation. For asynchronous communication, token-ring is utilized which is a well proven and standardized protocol. Token-ring provides a fair access method and should be applicable to higher speeds than those used at present. Token-ring in a time slot or time slots can thus be utilized in DTM, which is characterized by dynamic and synchronous transmission with mode division. The need is to add to and change synchronous information. One works with capacity and synchronizes the Not-Data signal. The advantages of topology, speed and coding (differential Manchester coding) which characterize the token-ring protocol can be implemented.

The said integration of speech and data in LAN

provides the users of the local area network with the possibility of access to computer-aided telephony, computer-aided PLUS services, computer-aided voice mail, business exchange services, ISDN services (image) and/or distributed radio programmes and/or distributed music, stereo (two channels are available).

LIST OF FIGURES

In the text below, an embodiment presently proposed for an arrangement which exhibits the significant features of the invention will be described with reference to the attached drawings, in which

Figure 1 shows in basic diagram form the structure of a local area network with integrated speech and data and interface to a public ISDN network,

Figures 2 - 2b show the distribution of bandwidth between speech and data with a hybrid access protocol,

Figure 3 shows in block diagram form a token-ring adaptor which is based on Texas Instruments TMS380 circuits,

Figure 4 shows in block diagram form hardware for an IVDLAN adaptor,

Figure 5 shows in block diagram form an example of a ring interface where a master unit supplies a clock signal to the ring and sends a start delimiter in the form of a unique octet,

Figure 6 shows in block diagram form the asynchronous section of the IVDLAN adaptor,

Figure 7 shows in block diagram form the synchronous section of the IVDLAN adaptor for speech with 64 kbit/s, and

Figure 8 shows in basic diagram form a single circuit-switched telephone call in which a communication unit node is assumed to administer setting-up and clearing.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

The figure shows a local area network IVDLAN which constitutes a local area network for integrated

speech and data. The network is connected to personal computers PC 1 and PC 2 of a type known per se. The respective personal computers are connected via a medium attachment unit MAU and a network communication unit NCU. A unit (telephone, microphone and so forth) has been symbolized by Speech. The unit operates with ISDN (integrated services digital network) or by analog means. The local area network IVDLAN can be connected to a public ISDN network which can be of a type known per se and is arranged for basic or primary access. Connection is carried out by a communication server CS, terminal adaptor TA and network terminal NT. Two reference points S and R are also specified in the figure.

Figures 2, 2a and 2b show the different transmission cases where first and second information items about speech, video and so forth and, respectively, data on the medium can share accessible space/bandwidths. Figure 2 shows the transmission of only data (P-INFO). In the figure, the bandwidth has been divided up equally between speech and data, and in Figure 2b the speech information has taken up a quarter of the bandwidth while the rest is allocated for data and so forth.

Figure 3 shows the structure of a conventional token-ring adaptor. Due to the fact that a special communication processor is included, the data communication in the network does not load the normal processes of the personal computer. A bus interface unit BIU is shown, as is a memory expansion unit MEU. The bus connections are specified with an adaptor bus. Moreover, a communication processor, protocol handler and system interface are included. There is a ring interface at the token-ring connection.

Figures 4-8 show the block diagrams for an IVDLAN adaptor according to the invention. Existing communication circuits for the token-ring system are included in the asynchronous section. The system operates in a time-division multiplexed relation. In accordance with Figure 4, the hardware is divided up into three parts, namely ring interface, asynchronous section and synchronous

section. The ring interface connects the adaptor to the ring and is common to the asynchronous and synchronous sections.

Figure 5 shows how received asynchronous data are buffered and repeated partly normally, partly how they serve as cycle master unit. Since the block diagram according to Figure 5 is of a type known per se, it will not be described in greater detail here, but reference is made to the text in the figures.

Figure 6 shows the asynchronous section with communication processors for token-ring. The computer is coupled to the received clock signal and to the local clock. Programmable time slot generators determine when the asynchronous section will be activated for receiving and transmitting. The start delimiter detector senses the bit pattern which indicates that a new synchronous frame is starting and resets the receiver computer to zero. The token-ring structure uses centralized clocking from a cycle master. The node which has the cycle master role also generates the start delimiter for the synchronous frame.

Figure 7 shows the synchronous section with speech transmission. Programmable time slot generators determine when the synchronous receiving and transmitting will occur. The received serial bit stream must first be decoded (it is coded in differential Manchester code). This is followed by serial/parallel conversion into 8-bit words. The data are then clocked to an output port when the time slot generator output is active. The data at the output port are forwarded to a speech encoder. On transmission, the activities occur in the reverse order. At the cycle master unit node, the local clock is used instead of the receiver clock and the time slot generator is coupled to a computer connected to the local clock. The parallel/serial convertor can also be controlled by different computers on transmission. When the synchronous section is active, repetition occurs when no transmission is in progress.

The arrangement comprises a software interface.

Towards the upper section of the data link layer LLC (Logical Link Control), calls (Service Primitives), data request and data indiction are used. These are the only service primitives which are used in connectionless transmission. The data request call has the following appearance.

```
DL-UNITDATA request(
                        source address
                        destination address
                        data
                        priority
                        )
```

Source address and destination address specify service access points for transmitter and receiver. Data specifies the data element which will be transmitted. Priority specifies the desired priority for the transmission. Analogously, the following applies to data indication:

```
DL-UNITDATA indication(
                        source address
                        destination address
                        data
                        priority
                        )
```

Software which is needed for setting-up and clearing synchronous connections is utilized. The common asynchronous channel is used for this purpose. Figure 8 shows the signals which are needed in setting-up and clearing a telephone conversation. Coded messages are transmitted to and from the data link layer through call data request and data indication. Since the communication in one embodiment will be ISDN oriented, all handling with setting-up and clearing occurs in accordance with CCITT standard Q.931. The signalling procedures correspond to the network layer in the OSI model. The standard is comprehensive and detailed. These procedures can be

applied for both internal and external connections in this application. In the case of internal connections, the common P channel is used for signalling and in the case of an external connection, the D channel is used. For the rest, reference is made to the Q.931 standard. The invention is also used as application program interface. Applications of an interface towards underlying network software called application program interface. If the application needs to utilize network services, it uses an application programming interface with the network software. The application program interface does not specify the layers the software comprises. Network services for setting-up and clearing synchronous connections are handled directly by the procedures in the network layer. Software for asynchronous data communication, for example for a file server, can use conventional existing network software. In connection with the setting-up and clearing of synchronous connections, time slots must be generated and, respectively, removed for the nodes inserted. Time slot generation is programmable and can be changed dynamically on demand. Concerning a change of time slot for the common asynchronous channel, this must occur when intercommunication is taking place. With a transmission speed of 16 Mbit/s, the local area network will cope with the following in one embodiment:

Normal data communication including signalling of 4.48 Mbit/s

one connection at 1.92 Mbit/s (only for occasional application, can be replaced by five connections at 384 Mbit/s)

five connections at 384 Mbit/s

thirty connections at 64 kbit/s.

Three last-mentioned demands are met with 3.84 Mbit/s.

In the new protocol for speech and data, the normal LAN data communication is carried out in such a manner that data messages cannot be sent in one sequence but must be divided up into parts of certain length

provided they are not very short. The space between the parts or segments is utilized for speech and image information. This is necessary since speech and image information must return with regular time intervals (so called isochronous information).

DTM (Dynamic synchronous Transfer Mode) is an access method for synchronous multiplexing and dynamic allocation of bandwidth. It is known to utilize this method for high communication speeds on optical fibre. Reference is also made to the technique in connection with a standard for integrating speech and data, namely IEEE 802.9, which, however, does not use the principle of common medium and distributed exchange functions. DTM is already well known and will not be described in greater detail here, but it will only be stated that, for compatibility with the asynchronous data communication which is normally used in a LAN, a number of time slots can be used for an asynchronous channel which is common to all computers which are connected to the local area network. For asynchronous messages which are longer than the number of allocated time slots for the asynchronous channel, a dividing-up must be carried out so that the message is transmitted in a number of synchronous frames. In this manner, the asynchronous communication is over-laid upon the synchronous communication. The access protocol according to the invention can be considered as a hybrid of circuit switching and packet switching. In accordance with the invention, the beginning and end of the asynchronous frames will be specified in a suitable manner. An asynchronous message frame is followed either by a new one from the same computer or from the token. After transmission of the message frame or token, padding is transmitted in a manner known per se.

In accordance with the invention, the common asynchronous channel is used, and for this to occur as effectively as possible it must be possible to locate the start and end delimiter anywhere in the sequence of time slots. The message which is delimited by start delimiter and end delimiter constitutes an asynchronous frame. The

asynchronous frame can extend over a number of synchronous frames. The length of an asynchronous message is only limited by the demand for a fair access to the common channel.

In accordance with the invention, a number of computers must be able to insert information into one and the same synchronous frame. Synchronization is thus carried out in the different computers with their different clock oscillators. It will be possible to use high speeds, which can be facilitated on transition to optical fibre. The token-ring principle can be applied in this connection. The ring consists of a number of point-to-point connections and therefore only one is transmitting at a time. The information is normally repeated in each node, which results in a delay of 1 bit. To go into and change or add to the received information is a normal measure. Each computer is therefore given the possibility to change its speech or video information even when a second computer is transmitting data in the same synchronous frame. The strength of the token-ring protocol lies in the fair access which can be obtained with the token which is sent around as soon as someone has finished transmitting data. The transmitted message is coded with differential Manchester coding. The code contains both data and synchronization information (clock). The code contains digital ones and zeros and there are also two Not-Data symbols. Since signals (time slots) containing Not-Data symbols cannot occur in data information, they can thus be used as special signals for delimiting frames. The token-ring protocol normally uses two such signals, one for start delimiting and one for end delimiting. In the composite hybrid protocol there is a need for at least one further such special signal for designating the start delimiter for a synchronous frame. After a message frame is transmitted, the padding to the token is transmitted. This padding can be carried out in a manner known per se. In accordance with the above, the synchronous section of the hybrid protocol used for speech and video is also coded with differential

Manchester coding. In synchronous information, speech and video is provided. This information is transmitted in channels which are set up. Bearer services are provided with speeds which can be made up of multiples of 64 kbit/s up to 20048 Mbit/s. One of the stations, suitably an active monitor, can be allocated the role of cycle master. This means that the station creates the start delimiter for a synchronous frame which is sent at the beginning of each cycle at 125 Ms intervals. The synchronization signal is one octet long. No terminating signal is needed since the frame comprises a specific number of octets, namely 250 for the transmission speed of 16 Mbit/s. Isochronous information is coded according to some standard. It is transmitted in the time slot which has been obtained on setting-up and is received by the receiver in the same time slot. A time slot can consist of one or more octets. Speech is coded with eight bits of 125 Ms each for the ISDN speech service. Speech coding can be carried out in accordance with CCITT recommendation G.711 for pulse-code-modulated speech. On transmission, parallel/serial conversion occurs and on reception serial/parallel conversion occurs. Before the information is transmitted on the ring, it is coded with differential Manchester coding and, on reception, decoding must first occur. Two types of frames can occur, on the one hand the basic synchronous frames and on the other hand the split asynchronous frames which are superimposed on the synchronous ones. Figures 9 and 10 show for a synchronous frame how in each case one asynchronous frame can be divided up over a number of synchronous frames.

Figure 9 in principle shows one frame format,

Figure 10 in principle shows how an asynchronous frame can be divided up over two synchronous frames following one another.

The C-INFO section contains circuit-switched channels D channel, B channel and C channel. The P-INFO section contains one P channel. In the D channel, the bearer service itself is provided as one channel for

64 kbit/s. The B channel can occur in two B1 and B2 channels corresponding to basic access in ISDN and can be used for speech and/or data per node. In this case, only the bearer service itself is provided as one channel for 64 kbit/s. The D channel can be used as bearer service for video or fast data transmission. The P channel is used for common asynchronous data communications (packet switching). In this connection, reference is also made to the OSI reference model. Figure 11 shows how the reference model for IVDLAN is related to the reference model for OSI. LLC means logical link control, MAC mean access control and LAPB, LAPD are protocols for data communication. In accordance with the token-ring principle, all units connected to the ring can listen in and receive when a unit is transmitting. In the ring network, it is only one station, the next in the ring, which can pick up the transmission, the frame travels around in the ring due to the fact that the stations, in order, copy bit by bit of the frame from the input and at the output. When the frame comes back after a turn around the ring, it is removed by the originator. One frame with a special appearance, the token, always travels around in the ring. A frame with data which is transmitted through the ring between two stations consists of the token which is modified and appended with an address field, information field and other parts which are used for data or checking. If no activity is occurring in the network, the token travels around by itself, this time with an appearance which indicates that it is free. When a station receives such a token, it has the right to transmit within a certain predetermined time. All stations check the address part in each received data frame in order to see if it should be copied into the station. This also provides the possibility of inserting certain information to the originator, among others for confirming that it has received the frame before it forwards the packet to the next station. When the originator gets the frame back, it can be removed and, if there is still time, the station can send another frame. The transmission speed is

8 Mbit/s or 16 Mbit/s. One of the stations or nodes is allocated the role of active monitor. It transmits with a crystal-controlled clock signal as reference. The other stations use a locked oscillator for synchronizing reception and transmission with the received signal. When the bit stream has passed around the ring and is received by the receiver of the active monitor which is locked to the received signal, the received bit stream is no longer in phase with the crystal-controlled clock. To compensate for differences, an elastic buffer is used which clocks the received data with the locked clock and transmits data with the crystal-controlled clock. The token-ring protocol uses a signalling format which is called differential Manchester coding of a type known per se. As regards the format, a frame format is referred to which is already known. This also applies to the functions for frame checking, destination address, source address and so forth. The structure of the asynchronous frames is also considered to be previously known. With regard to the token, there are two possibilities of transmitting this, among others, directly after the transmission of the information frame (early token release). This procedure entails increased effectiveness in the present case. The abort function is also already known.

In Figure 9, CSD specifies the start delimiter for a synchronous frame. C-INFO specifies circuit-switched information, with speech, video, data and signalling. P-INFO shows common packet-switched information, data only. D1 is a D channel for signalling node 1, 64 kbit/s, 1 octet. B11 specifies a B1 channel for speech or data node 1, 64 kbit/s, 1 octet. B21 specifies a B2 channel for speech or data node 1, 64 kbit/s, 1 octet. C1 specifies a circuit-switched channel for video node 1, 128 kbit/s, 2 octets. B12 specifies a B1 channel for speech or data node 2, 64 kbit/s, 1 octet, C2 constitutes a circuit-switched channel for video node 2, 384 kbit/s, 6 octets. SD is a start delimiter for asynchronous frames. AC is an access control unit and FC a frame control unit or type of frame. DA specifies a destination

address and SA a source address. LLC is a protocol for upper data link level and FCS is an error check of 4 octets. The end delimiter of 1 octet is indicated by ED and the frame status by FS, 1 octet. FILL is the padding consisting of, for example, only zeros, to the next SD.

Figure 10 shows how an asynchronous frame can be divided up into two synchronous frames following one another and inserted into its P field. The unspecified part of the synchronous frames contains fields for synchronization of speech and image information. The number of synchronous frames which return for dividing up is determined by the length of the asynchronous frame and the length of the P field. The designations in the asynchronous frame specify fields with different significance and length. The asynchronous frame can begin and end anywhere in the P field.

The invention is not limited to the embodiment shown above by way of example but can be subjected to modifications within the scope of the following patent claims and inventive concept.

Figure 1

1) Public ISDN network
Basic or primary access

2) Speech Speech

3) LAN bridge

4) ISDN or analog

Figure 3

1) Communications processor

2) Host system connection

3) System interface

4) Access bus

5) Protocol handler

6) Ring interface

7) Memory interface

8) Adaptor memory

9) BIU = Bus interface unit

10) MEU = Memory expander unit

11) Token-ring adaptor based on Texas Instruments TMS 380 circuits

Figure 2

1) Transmission speed

2) Data only

3) Time

Figure 2a

1) Transmission speed

2) Speech video

3) Time

4) 125 microseconds

5) Speech and data, bandwidth divided equally

Figure 2b

1) Transmission speed

2) Speech video

3) Time

4) 125 microseconds

5) Speech and data, 1/4 of bandwidth for speech and remainder for data

6) Principle of integrating speech and data by means of a hybrid access protocol

Figure 4

1) Ring input

2) Asynchronous section

3) Synchronous section

4) Ring interface

5) Ring output

6) Hardware overview for IVDLAN adaptor

Figure 10

1) Asynchronous frame for token ring

2) Unspecified

3) Synchronous frame 1

4) Synchronous frame 2

5) 125 microseconds

6) Figure shows how an asynchronous frame has been divided up into two synchronous frames following one another and has been inserted in their P field. The unspecified part of the synchronous frames contains fields for synchronization and speech and image information. The number of synchronous frames which is returned for division is determined by the length of the asynchronous frame and the length of the P field. The designations in the asynchronous frame specify fields with different significance and length. The asynchronous frame can begin and end anywhere in the P field.

Figure 5

1) Ring input

2) Receiver data

3) Receiver clock

4) Local clock oscillator

5) Input/output

6) Minimum buffer

7) Input

8) Output

9) Elastic buffer for cycle master

10) Normal node

11) Rep/transmission

12) Synchronous transmit data

13) Asynchronous/synchronous rep/transmission

14) Synchronous control

15) Asynchronous repetition and transmit data

16) TMS 38053-16 with associated components

17) Ring output

18) Preliminary block diagram for ring interface. Cycle master provides clock signal for the ring and transmits start delimiter (unique octet).

19) Transmit clock

Figure 6

1) Communication processor for token-ring TMS380C16 and memory

2) Receiver data

3) Local clock

4) Receiver clock

5) Time slot generator

6) TDM control

7) Start del. detector

8) Receiver computer

9) Asynchronous rep/transmission of data

10) Normal node

11) Computer for local clock

12) Time slot generator, rep/trans.

13) Local clock

14) Async./sync. repetition/transmission, control

15) Start del. generator

16) Synchronous transmit data, or function

17) Synchronous repetition/transmission or function

18) Preliminary block diagram for asynchronous part of IVDLAN adaptor

Figure 7

1) Receiver clock 16 MHz

2) Receiver clock 32 MHz

3) Serial/parallel conversion and output logic

4) Decoding

5) Synchronous receiver data

6) To speech decoder, 8 bits, 64 kbit/s

7) Activation

8) Address control from receiver computer

9) Receiving

10) Programmable time slot generator, receiving

11) From receiver computer

12) 16 MHz local clock

13) 32 MHz rec. clock

14) Normal node

15) From speech encoder, 8 bits, 64 kbit/s

16) Input logic and parallel/serial conversion

17) Encoding

18) Synchronous transmit data

19) Control, repetition/transmission

Figure 7 (continued)

20) From computer for local clock

21) Programmable time slot generator, repetition/transmission

22) Address control from computer

23) Receiver computer

24) Computer for local clock

25) Preliminary block diagram for IVDLAN adaptor, synchronous section for 64 kbit/s speech

Figure 8

1) Caller terminal

2) Preparation

3) Communication service

4) Called terminal

5) Preparation acknowledged

6) Information

7) Preparation

8) Readiness

9) Call process

10) Setting-up

11) Setting-up acknowledged

12) Setting-up acknowledged (optional)

13) Data stream

14) Called terminal hangs up first

15) Clearing

16) Clearing

17) Releasing

18) Releasing carried out

19) Calling terminal hangs up first

Figure 8 (continued)

20) Signalling with single circuit-switched telephone call.
One communication centre is assumed to administer setting-up and clearing

Figure 9

1) Synchronous frame
2) Variable limit
3) Node 1
4) Node 2
5) Synchronous information
6) P-frame 1
7) Asynchronous frame part 1
8) Asynchronous frame part 2
9) Asynchronous frame part 3
10) Start of new frame
11)

CSD	Circuit switching starting delimiter
C-INFO	Circuit-switched information, speech, video, data, signalling
P-INFO	Common packet-switched information, data only
D1	D channel for signalling node 1, 64 kbit/s, 1 octet
B11	B1 channel for speech or data node 1, 64 kbit/s, 1 octet
B21	B2 channel for speech or data node 1, 64 kbit/s, 1 octet
C1	Circuit-switched channel for video node 1, 128 kbit/s, 2 octets
B12	B1 channel for speech or data, node 2, 64 kbit/s, 1 octet
C2	Circuit-switched channel for video node 2, 384 kbit/s, 6 octets
SD	Start delimiter for asynchronous frame
AC	Access control
FC	Frame control, type of frame
DA	Destination address
SA	Source address
LLC	Logical link control, protocol for the upper data link level
FCS	Frame control sequence, error control, 4 octets
ED	End delimiter, 1 octet
FS	Frame status, 1 octet
FILL	Padding consisting of, for example, only zeros, to next SD

PATENT CLAIMS

1. Arrangement in a communications network (IVDLAN) for transmitting synchronously transmittable first information items, for example speech, video and/or data, and asynchronously transmittable second information items, for example data. The asynchronously transmittable second information items can be overlaid on the synchronously transmittable first information items. On transmission, the accessible bandwidth can be variably distributed between said first and second information items and, with the desired varied distribution, transmitting and receiving units become synchronized by means of synchronization information transmittable via a channel, established, for example, in the asynchronous transmission, between the transmitting and receiving units, characterized in that it operates with a synchronous first protocol of the DTM type (Dynamic Synchronous Transfer Mode) and one or more examples of an overlaid asynchronous second protocol of the token-ring type (for example, token-ring or FDDI (Fiber Distributed Data Interface)), which operates with high access fairness. According to DTM, one cycle consists of a particular number of time slots where each time slot consists of a particular number of bits and the smallest unit for allocation of bandwidth corresponds to one time slot. The synchronous protocol is arranged for dynamic bandwidth allocation. The overlaying effected by means of the second protocol is arranged to occur in at least one time slot with a variable number of bits.

2. Arrangement according to Claim 1, characterized in that the asynchronously transmittable second information items can be overlaid on the synchronously transmittable first information items and that a bandwidth accessible on transmission can be variably distributed between said first and second information items, in which a small part of the bandwidth space for the synchronous transmission is taken up for the purpose of synchronization and the synchronous transmission occurs in cycles, the length of time of which is determined by

a desired sampling frequency. A synchronous first protocol, together with an asynchronous second protocol, forms a hybrid access protocol.

3. Arrangement according to Claim 1 or 2, characterized in that the synchronous protocol is arranged for dynamic bandwidth allocation.

4. Arrangement according to Claim 1, 2 or 3, characterized in that it utilizes, in combination of principles for a synchronous and asynchronous protocol, one or more of the characteristics topology, transmission speed and coding from the principle of the asynchronous protocol as complement to the principle of the synchronous protocol.

5. Arrangement according to any of the preceding claims, characterized in that it operates with one or more examples of an overlaid second protocol, which corresponds, as closely as possible, to the token-ring standard/proposed standard according to ISO 8802-5.

6. Arrangement according to any of the preceding claims, characterized in that it operates with one or more examples of an overlaid second protocol which corresponds, as closely as possible, to the FDDI standard/proposed standard according to ISO 9314.

7. Arrangement according to Claim 1, 2 or 3, characterized in that setting-up and clearing of synchronous connections occurs via a common data communication channel, preferably an asynchronous data communication channel.

8. Arrangement according to any of the preceding claims, characterized in that it comprises or forms an ISDN-compatible business exchange with connection-oriented speech, video and/or data communication and connectionless data communication.

9. Arrangement according to any of the preceding claims, characterized in that it comprises multi-function terminals, which means terminals for handling both data and speech, video, music, and so forth, which terminals comprise or consist of personal computers.

10. Arrangement according to any of the preceding claims, characterized by forming from this arrangement a

local area network which renders unnecessary, in relation to the network, a separate business exchange which instead is represented by software in the local area network.

11. Arrangement according to any of the preceding claims, characterized in that, in a combination of DTM and token-ring principles, characteristics, for example topology, transmission speeds and/or coding, and so forth from the token-ring principles, are used as complement to the DTM principles.

12. Arrangement according to any of the preceding claims, characterized in that it utilizes a hybrid access protocol for integrating speech, video and data in local area networks for speeds of up to 20 Mbit/s.

13. Arrangement according to any of the preceding claims, characterized in that one and the same local area network with personal computers can be used for all types of communication, primarily speech and data.

14. Arrangement according to any of the preceding claims, characterized in that this arrangement forms a local area network which renders unnecessary, in relation to the network, a separate business exchange which instead is represented by software and/or distributed hardware in a network interface in the local network.

15. Arrangement according to any of the preceding claims, characterized in that this arrangement forms a local area network which can communicate with external ISDN communication via one or more bridges from or in one or more communication servers.

16. Arrangement according to Claim 12, characterized in that a respective terminal in the local area network and respective server is arranged with an interface to the local area network.

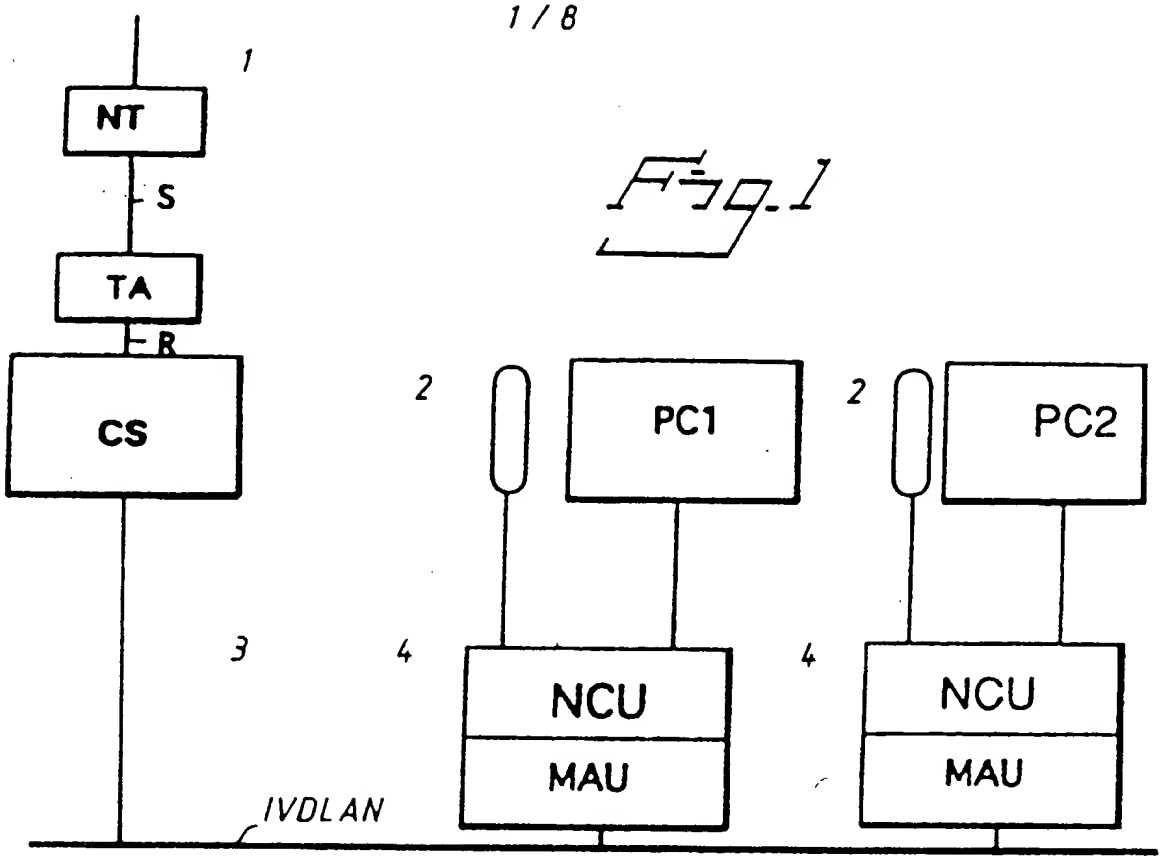
17. Arrangement according to any of the preceding claims, characterized in that a local area network formed by this arrangement or included in this arrangement is transparent for normal data communication occurring in the network.

18. Arrangement according to any of the preceding

claims, characterized in that it comprises a multi-services network with multifunction terminals.

19. Arrangement according to any of the preceding claims, characterized in that it can be used both for narrow-band and broadband techniques.

20. Arrangement according to any of the preceding claims, characterized in that it comprises or forms an ISDN-compatible business exchange with connection-oriented speech, video and/or data communication and connectionless data communication.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IVDLAN

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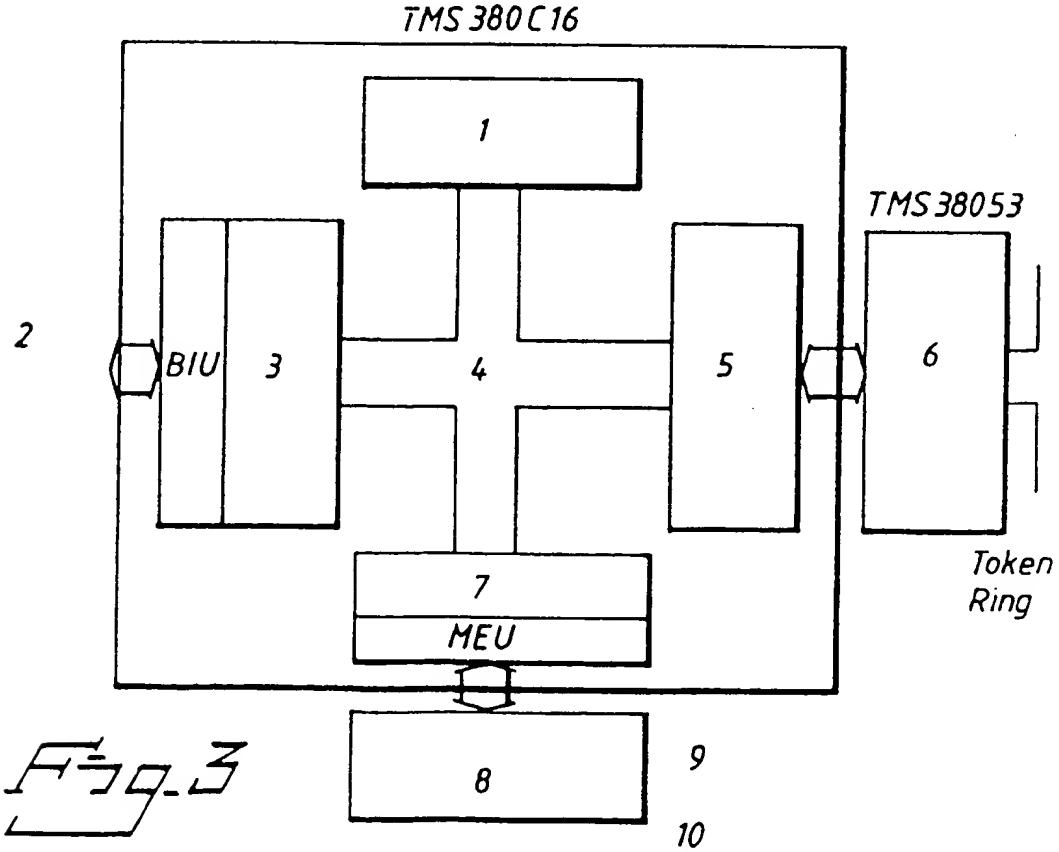
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TMS 38053
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MEU
Token
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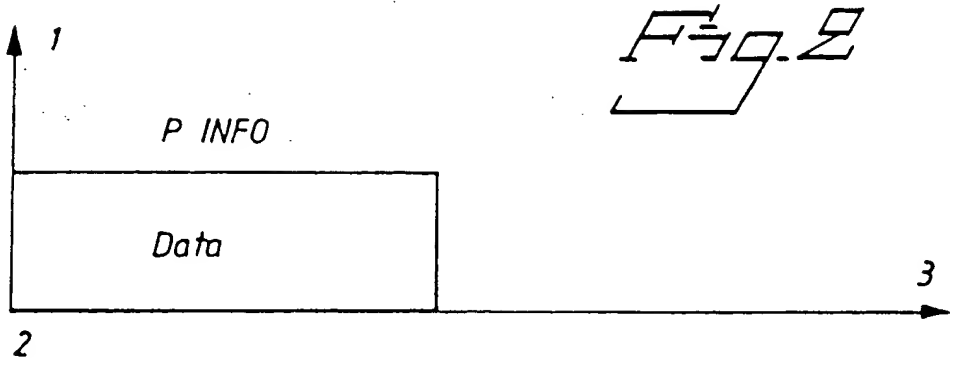
Fig. 3

Fig. 2



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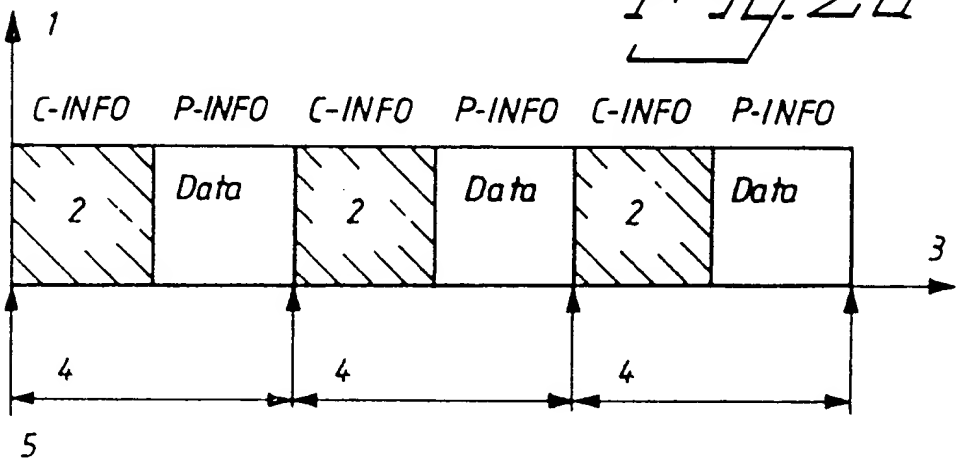

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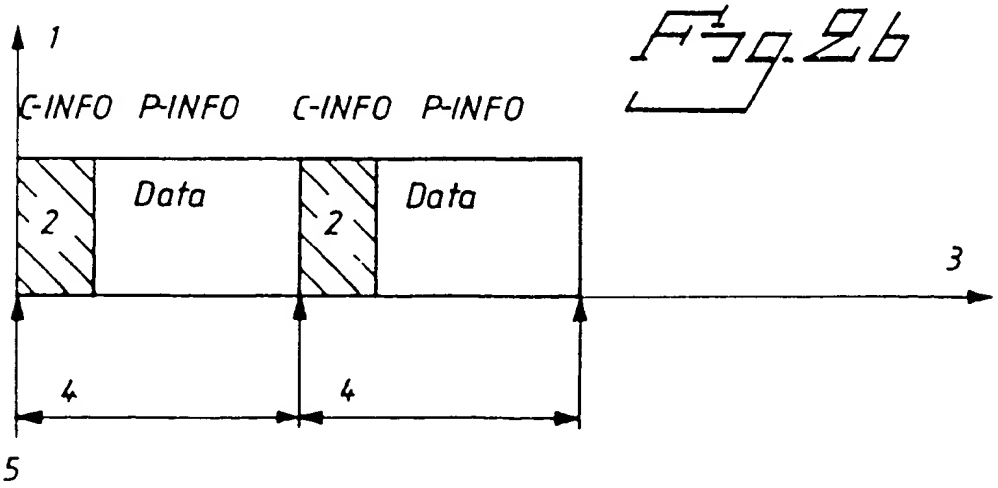

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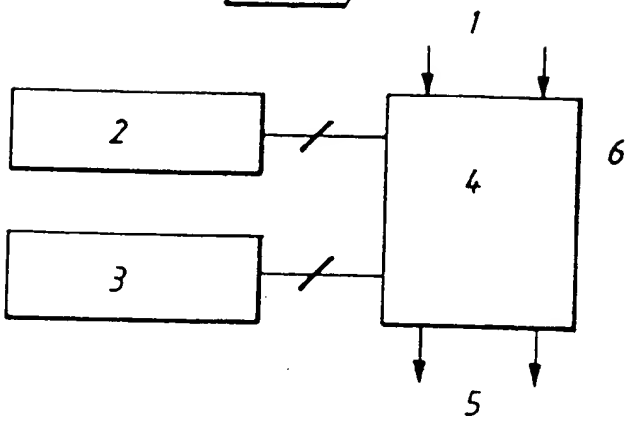
Fig. 4



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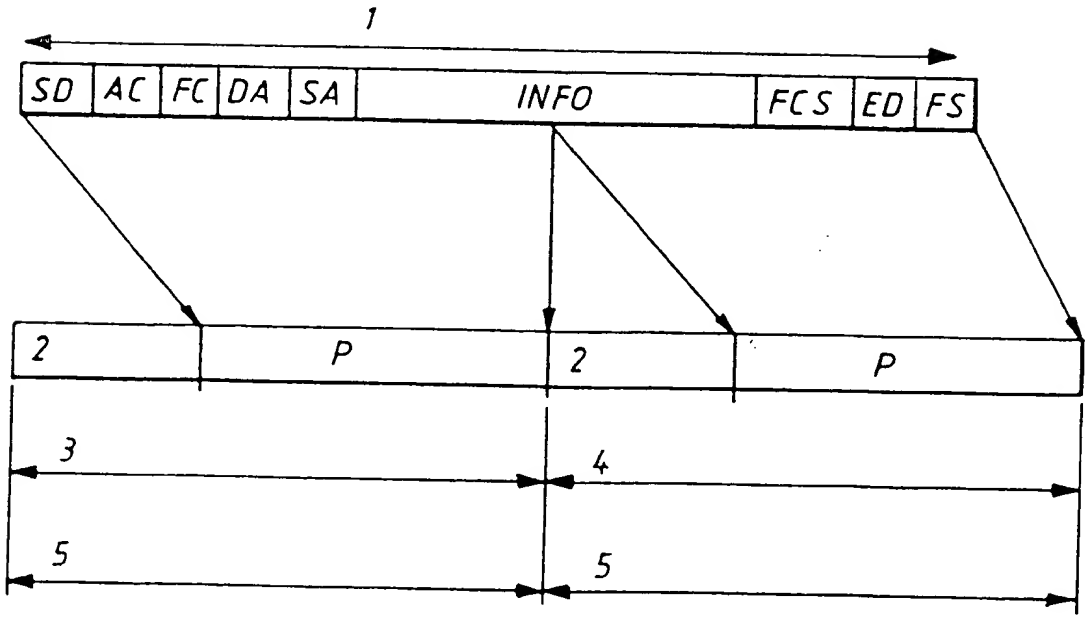

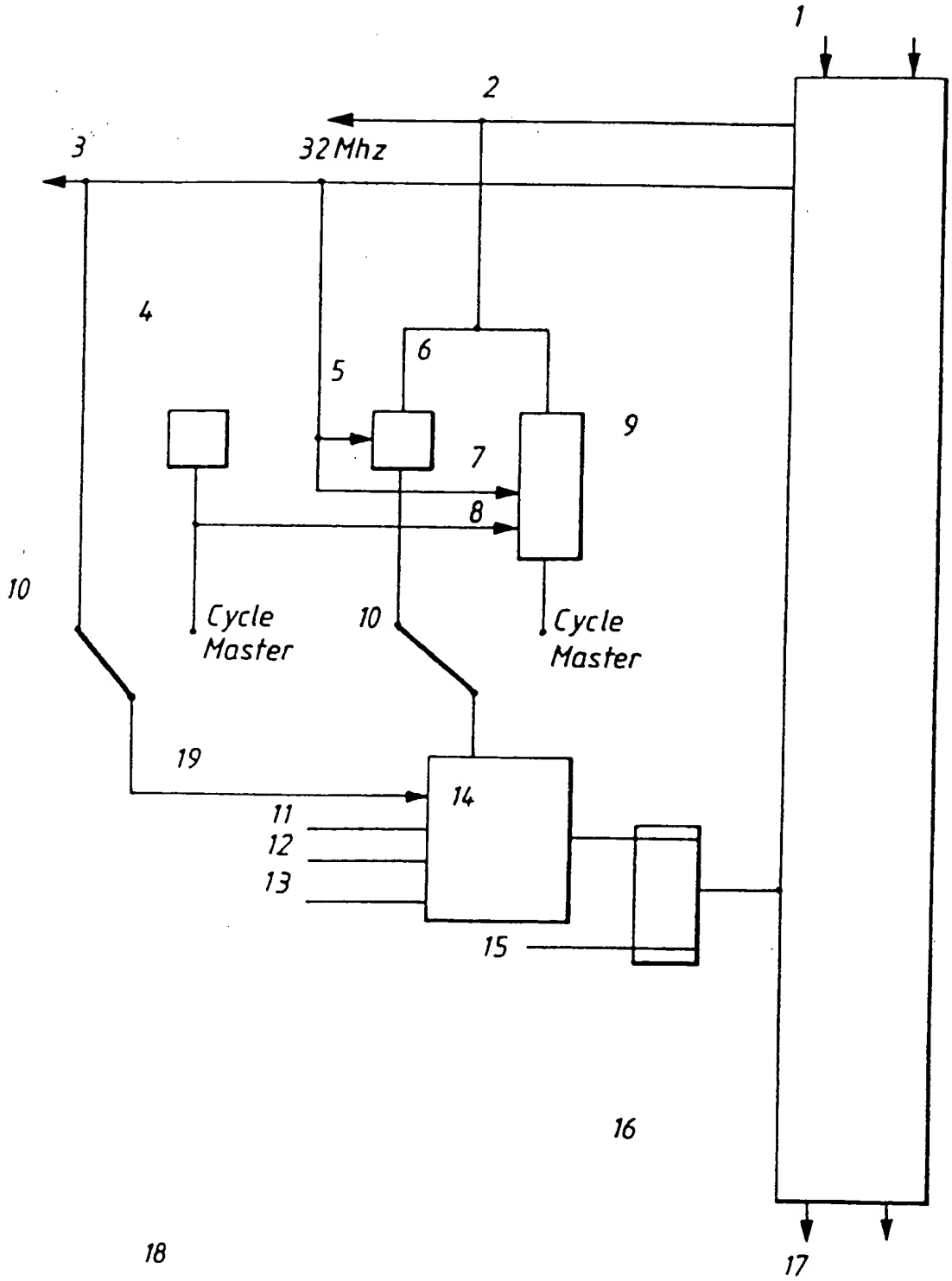
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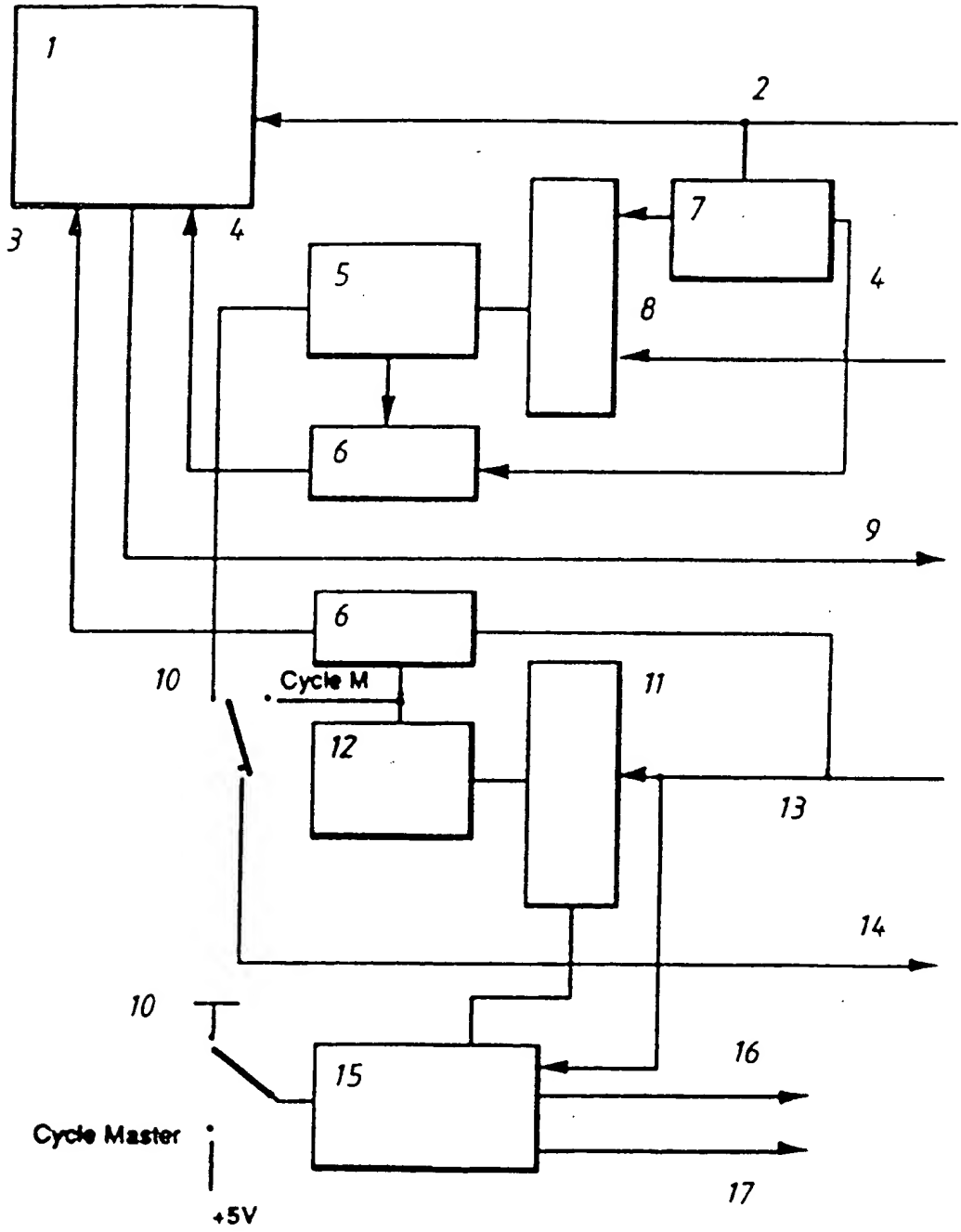
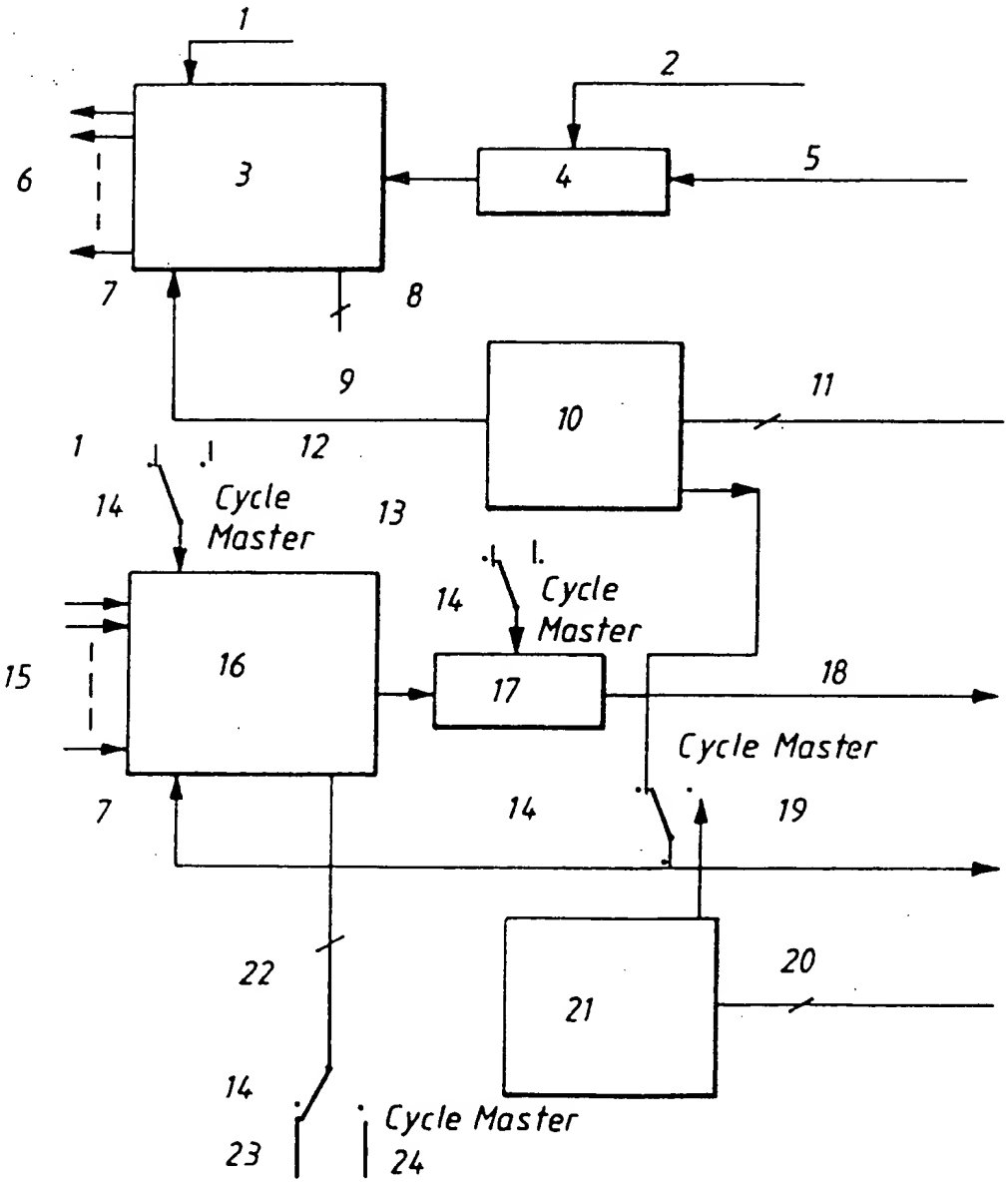
Fig. 5

Fig. 6

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Cycle Master
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Fig. 7

Fig. 8

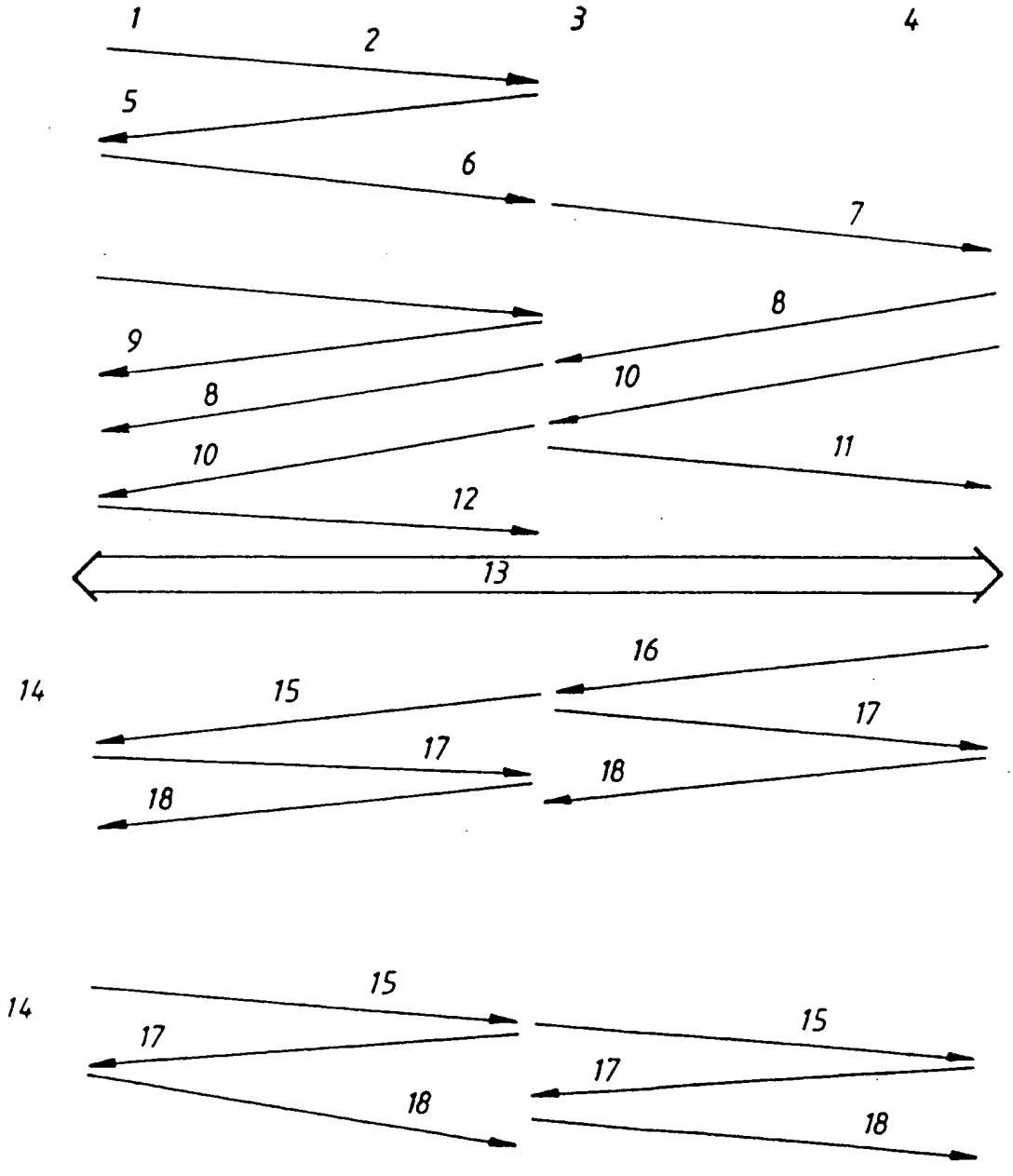
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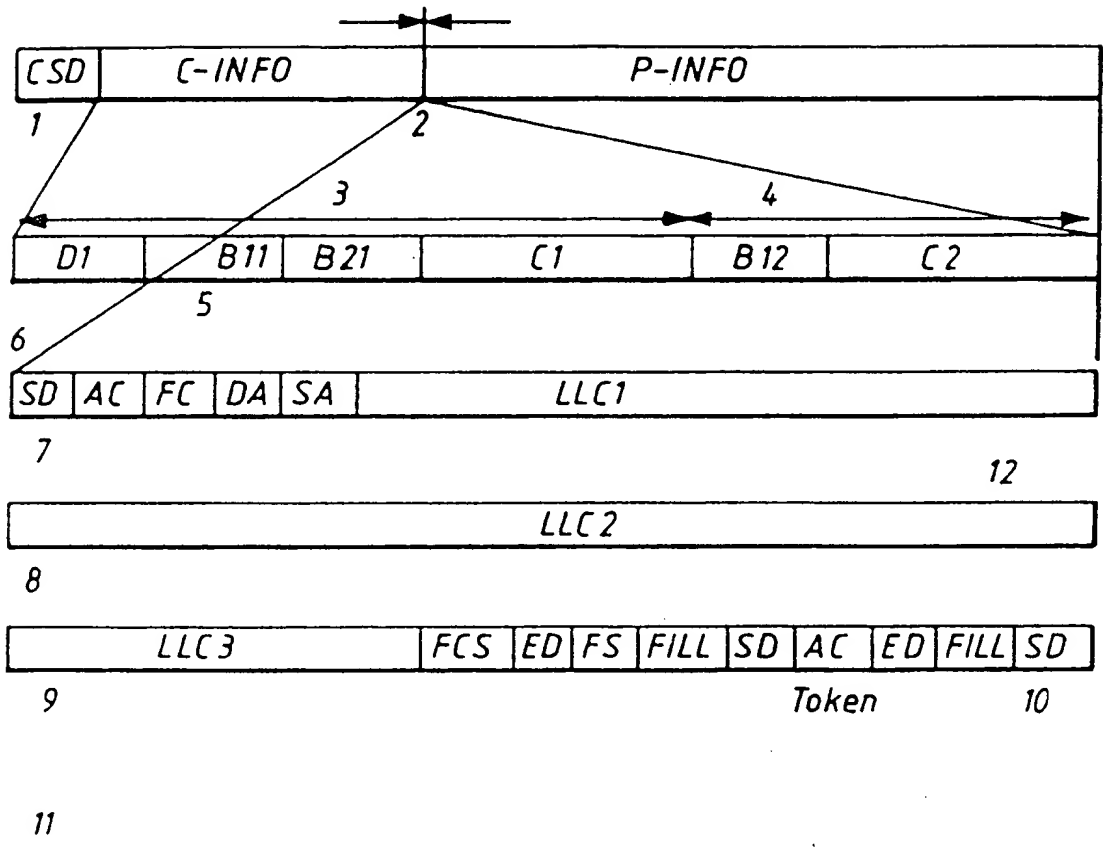
Fig. 9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LLC2
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LLC3
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ED
FILL
SD
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Token
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INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 93/01069

A. CLASSIFICATION OF SUBJECT MATTER

IPC5: H04J 3/16, H04L 25/30, H04L 25/38
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC5: H04J, H04L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

DIALOG: WPI, CLAIMS

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP, A2, 0343319 (TELENORMA TELEFONBAU UND NORMALZEIT GMBH), 29 November 1989 (29.11.89), claims 1-8, abstract ---	1
A	US, A, 4665518 (KEITH S. CHAMPLIN ET AL), 12 May 1987 (12.05.87), column 36, line 59 - column 44, line 59 ---	1
A	US, A, 5043981 (FARZIN FIROOZMAND ET AL), 27 August 1991 (27.08.91), abstract --- ---	1

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
15 March 1994	28 -03- 1994
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Sven-Olof Wirlée Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

Information on patent family members

28/01/94

International application No.
PCT/SE 93/01069

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP-A2- 0343319	29/11/89	DE-A,C- 3817407	30/11/89
		DE-A- 3916850	06/12/90
		DE-A- 3919154	13/12/90
US-A- 4665518	12/05/87	DE-A- 3586911	04/02/93
		EP-A,B- 0152013	21/08/85
US-A- 5043981	27/08/91	EP-A- 0459757	04/12/91